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Environment, Ability, Effort, and Earnings

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Abstract

This paper explores, in unique detail, the effects of peers, friends, family, individual ability and individual effort, measured in the last year of high school, on labor market success at ages 35 and 53. These effects are surprisingly persistent. Contextual effects matter at both ages: Socialization, role models and community wealth are important, but ability spillovers are not. IQ has significant but modest effects at both ages. Effort does as well, and is responsible for 40% of IQ's apparent effects. In consequence, arguments such as those in The Bell Curve are overstated. Feasible increases in effort and education can compensate for the effects of many cognitive and contextual deficits.

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Economic success depends both on an individual's internal resources and the context in which the individual develops them. Internal resources consist of innate human capital, the capacity to augment any such 'endowment' through additional investments and the work effort derived from this capital. 'Context' comprises the family, school and community resources which may contribute to the productivity of these efforts.

There is a vast literature examining the relationship between wages or earnings and personal characteristics that can serve as proxies for the gross accumulation of human capital, such as age, education, labor market experience, gender and race. However, there are perhaps no more than a dozen papers that examine the relationship between earnings and pre-labor market measures of intellectual capacity. Only one examines the extent to which any such relationship persists through the peak earning years.

Similarly, relatively little is known about the relationship between contextual effects and subsequent wages or earnings. Two recent reviews together identify only eight papers that address this issue (Haveman and Wolfe (1995), Jencks and Mayer (1990)). Collectively, they demonstrate that income as a young adult is related to characteristics measured during childhood and adolescence. However, they offer little conclusive evidence regarding temporal, social or spatial 'proximity': the span within the life-cycle during which these effects are important, the degree of personal intimacy necessary to generate them, or the geographic area within which they are concentrated.

Analyses that do not incorporate measures of both individual capacity and context must be interpreted with care because the two are almost surely correlated: More able children are likely to be offered richer environments, at least educationally. Richer environments presumably stimulate the development or realization of ability. To the extent that capacity is inherited, more able parents are more likely to be able to afford the inputs that create richer environments, and to have more able children.

However, analyses that include measures of both individual capacity and context require unusually detailed data. In consequence, the intersection of the literatures discussing the effects of cognitive ability and contextual effects on earnings consists, arguably, of only Kiker and Condon (1981). This paper constitutes another member of this intersection. It presents new evidence regarding the contributions of both individual intellectual capacity and adolescent context to earnings. It simultaneously estimates the contributions of IQ, characteristics of family, high school friends, high school peers and their families, and high schools to earnings at ages 35 and 53.

These estimates are noteworthy, first, because an extensive array of covariates minimizes the biases attributable to any omissions. Second, this is one of only a very few papers to examine the magnitudes of these contributions at ages beyond the mid-thirties. Third, the estimates of contextual contributions here are distinctive because they derive from a uniquely exhaustive description of the entire hierarchy of contexts, from family through friends to high schools. Fourth, the estimated contributions of intellectual capacity are especially compelling because they are purged not only of correlated contextual effects, but also of correlated contributions from effort. Lastly, the estimates here are the first to evaluate the relative contributions to earnings of cognitive ability and the effort devoted to academic achievement during adolescence.

I. IQ and earnings

Previous evidence regarding the relationship between intellectual capacity and earnings is not entirely consistent. Several papers suggest that it is unimportant: Kiker and Condon (1981) and Cohn and Kiker (1986) estimate that the ability measure in the Panel Study of Income Dynamics (PSID) has negligible effects on log earnings.[1] Murnane, Willett and Levy (1995, 259) estimate that a difference of approximately one standard deviation in mathematics achievement scores has "a very modest impact" on wages for 24 year-old males in 1978, though a larger effect in 1986. Bound, Griliches and Hall (1986, 94) conclude that, in the National Longitudinal Study of Youth (NLSY), "(t)he role of the [unobserved] 'ability' factor in the wage equation is marginal, both in the sense that its coefficients are not significantly different from zero and in the sense that it contributes little to the explanation of the variance of wages."[2]

However, Jencks et al. (1979, chapter 4) estimate returns of approximately 15 percent to income for each standard deviation of measured ability, using several sixth grade tests for 692 individuals enrolled in the Kalamzoo, Michigan school district between the years of 1928 and 1952. Bishop (1989) adopts .190 as his central "estimate of the response of the logarithm of the wage to a one population standard deviation change in adult GIA [general intellectual achievement]" among males in the PSID. Neal and Johnson (1996) estimate a log wage response of .172 to a standard deviation change in Armed Forces Qualification Test (AFQT) scores among males in the NLSY. Cameron and Heckman (1993, tables 2 and 10) imply returns of 7-10% to this change among NLSY respondents.

These estimates suggest that the difference in earnings associated with a one standard deviation difference in measured cognitive ability is equal to that associated with a difference of at least one, and perhaps as many as three years of schooling.[3] Gottfredson, et al. (1997, 14) conclude that "(w)hatever IQ tests measure, it is of great practical and social importance." Heckman (1995, 1107) concurs. The preeminence of IQ is arguably the principal, and certainly a controversial, theme in Herrnstein and Murray (1994).

This paper estimates the effects of IQ, measured at age 17, on earnings at ages 35 and 53. Only two other known studies include observations towards or at the end of the peak earnings years.[4] In contrast to the work here, Jencks et al. (1979) and Bishop (1989) pool observations

[1] With cognitive ability scores rescaled to standard deviations of 15, both papers estimate that even statistically significant effects of ability on earnings are unimportant.

[2] Blackburn and Neumark (1993) estimate small and often negative wage effects for what they call the 'academic test' in the NLSY, in the presence of other NLSY test scores.

[3] Heckman (1995, 1111-2) concludes that, "(o)n average, an extra year of schooling still increases earnings by at least a substantial 6-8 percent". However, Ashenfelter and Krueger (1994, 1171) assert that "the returns to schooling in our data are never less than 9 percent per year completed" and appear to be 12-16 percent.

[4] Observations are 24 years old in Murnane, Willett and Levy (1995), between 26 and 29 in Neal and Johnson (1996), between 19 and 32 in Kiker and Condon (1981), between 26 and 38 in Bound, Griliches and Hall (1986) and apparently between the early thirties and early forties in Cohn and Kiker (1986).

from many cohorts.[5] Only Jencks et al. (1979) examines the persistence of the relationship between adolescent cognitive ability and labor market earnings.

II. The theory and measurement of contextual effects

Child development almost universally takes place within the context of families. Accordingly, the success of that development may depend on parental wealth and effort (Becker and Tomes (1986)). It may also depend on the number and types of siblings who compete for shares in parental resources.

However, broader contextual effects may also alter individual behavior, through several social mechanisms. Jencks and Mayer (1990, 113-5) list models of epidemics, collective socialization and institutional influences as implying positive relationships between contextual activity and individual behavior. Respectively, these models predict that individuals are more likely to adopt and pursue an objective if these choices are popular among their peers, are encouraged by neighborhood adults or external authorities.

Positive effects are also possible through explicitly economic relationships. Peer ability may be an important input in the educational production function (de Bartolome (1990)). Adults may influence adolescent choices by providing, by example, information regarding the returns to investments in human capital (Durlauf (1994), 840, Montgomery (1991)). Exposure to employed adults may affect the quantity and quality of labor market contacts available to individuals entering the labor force (O'Regan and Quigley (1993)).

At the same time, the social and economic consequences of contextual effects are not necessarily constructive (Jencks and Mayer (1990) 116-7). Individuals may assess their chances for success as based on the differences between their own ability or status and the average abilities or status levels of their peers. Those who are less able or exalted may react to the perception of 'relative deprivation' by reducing their subsequent investments in human capital.

Other mechanisms may amplify these reactions. With limited resources or opportunities, increases in the number of colleagues with greater ability or resources will also discourage effort on the part of individuals with smaller endowments.[6] If the variance in resources or performance is sufficient, individuals experiencing relative deprivation may form a critical mass, leading to a 'deviant subculture' which provides, in effect, internal incentives to limit effort and human capital investments.

[5] IQ measurements as of late high school are appropriate here because the issue is whether interventions at high school or college ages can compensate for cognitive deficits in the determination of earnings during the peak years. In addition, these measurements can incorporate only limited experience effects. In contrast, Bishop (1989, 180) requires "that GIA [general intellectual achievement] be measured long after the completion of schooling and as close as possible to the date of the wage rate observations" because "the more recent test is by far the more powerful predictor of earnings". Achievement test scores that are contemporaneous with earnings measures must derive some of their predictive power from their relationship with work experience (Bishop (1989, 179) and Neal and Johnson (1996, 873)).

[6] This result is familiar in the tournament literature (Lazear and Rosen (1981), McLaughlin (1988)).

Aggregate effects can also be negative. de Bartolome (1990) demonstrates that household optimization in response to contextual externalities may lead to inefficient social outcomes. Benabou (1993) presents a model in which these inefficiencies can lead to "the collapse of the productive sector" (pg. 619). They may also lead to inequities: Durlauf (1994) describes how contextual effects might be responsible for the formation of persistently disadvantaged communities.

Discrimination among the various hypothesized contextual mechanisms requires measures describing a multitude of different contextual levels. In practice, available data are limited to the point that few if any of the previous studies have examined the relative effects associated with different levels.

Moreover, the most intimate measured context outside of the family is usually the 'neighborhood'. This concept has a variety of implementations, as examples, the high school (Evans, Oates and Schwab (1992)), the census tract (Brooks-Gunn (1993)) and the zip code (Datcher (1982), Corcoran et al. (1992)). Tracts and zip codes are, at best, poor approximations to neighborhoods because little is known about the intensity of the interactions between sampled individuals and others sharing this same geographic area. Schools are better approximations, because those attending the same school must have some minimal association. Definitions embodying more intimate relationships appear only in Case and Katz (1991), where individuals apparently responded to questions regarding their neighborhoods based on self-defined boundaries, analytical neighborhoods "roughly one or two square blocks in size" (pg. 14).

In addition, the contextual effects studied most thoroughly are those on social behaviors that are contemporaneous or near-contemporaneous, such as cognitive performance, high school graduation, educational attainment, child-bearing, sexual and criminal activities as teen-agers or young adults (Jencks and Mayer (1990)). Effects on earnings or wages have received much less attention. Furthermore, the extent to which these effects persist through adulthood is unknown.

III. Data and method

The Wisconsin Longitudinal Study of Social and Psychological Factors in Aspiration and Attainment (WLS) contains information regarding 10,317 individuals, who together constitute approximately one-third of all seniors in Wisconsin high schools in 1957.[7] The WLS includes self

[7] All WLS respondents graduated from high school (Hauser and Sweeney (1997, 542)). School enrollment rates were .880 among 14 through 17 year olds in the East North Central region in 1958 (Goldin (1994)) and .883 among 16 and 17 year olds in Wisconsin in 1960 (U.S. Bureau of the Census (1963b)). The ratio of high school graduates to 17 year olds in the East North Central region in 1958 was .610 (Goldin (1994)).

-responses from sample members, parental responses and administrative data, collected in a series of surveys beginning in 1957, and continuing in 1964, 1975 and 1993.[8]

By definition, this data set is restrictive. In particular, Wisconsin high schools in 1957 contained very few black or Hispanic students.[9] Wisconsin was also a relatively wealthy state. It presumably contained few of the severely disadvantaged neighborhoods that are the focus of, for example, Freeman (1986), Case and Katz (1991) and Wilson (1996).[10]

However, these limitations are advantageous, analytically. The possible contextual effects associated with race, segregation and extreme poverty are especially vexed and intricate (Corcoran and Adams (1997), Jencks and Mayer (1990), Wilson (1996)). More typical contextual effects may be easier to discern in their absence.

In addition, the WLS provides extensive data regarding many of these other effects. Table 1 presents averages of the contextual variables used here, for the sample of 2,959 male respondents analyzed below. The public use version of this data set identifies the population of the town in which each respondent attended high school, but no other population characteristics. Here, these towns are characterized by dummy variables identifying those with less than 10,000 and more than 49,999 in population.[11] The WLS also provides three variables that identify high school auspice and size of graduating class. Sample averages for these variables, which represent the 'outermost' contextual level, appear in the first two panels of table 1.

[8] Robert M. Hauser, William H. Sewell and J. Kenneth Little are the principal investigators for the WLS. The Inter-University Consortium for Social and Political Research distributes it as data set number 6163. Sewell and Hauser (1980) provide a general description. Haveman and Wolfe (1995, 1840) describe the large body of research based on the WLS as having "heavily influenced subsequent work in both quantitative sociology and economics".

[9] In 1960 only 1.93% of all Wisconsin high school students were non-white (U.S. Bureau of the Census (1963b)). Nonwhites comprised 2.35% of the entire Wisconsin population. "Negros" comprised 1.89%. The WLS does not record respondent race, only parent ancestry. The sample of table 3 below contains fewer than ten individuals who identify their paternal ancestry as "African".

[10] According to the U.S. Bureau of the Census (1963a, 1963b), the 1959 median incomes in current dollars for families and unrelated individuals in Wisconsin and in the U.S. were $5,173 and $4,791, respectively. In Wisconsin, 11.5% of all families and unrelated individuals had 1959 incomes below $1,000, and 20.5% below $2,000. The analogous proportions for the U.S. were 12.8% and 23.3%.

[11] Wisconsin cities with 1960 populations in excess of 49,999 were Green Bay, Kenosha, Madison, Milwaukee, Racine, Wauwatosa and West Allis. All but the last two exceeded this threshold in 1950 as well (U.S. Bureau of the Census (1963b)).

The WLS also contains a wealth of unique information regarding four more intimate contextual levels, as well as detailed information regarding respondent families.[12] The analysis here defines 'peers' as high school classmates. An anonymous code distinguishes the high schools attended by WLS respondents. The sample therefore identifies, on average, one-third of each respondent's classmates. The average characteristics of all respondent classmates, male and female, and their parents therefore represent two additional levels of peer effects.[13]

The third panel of table 1 presents three variables that measure characteristics of peer families. The estimated effects of these variables may discriminate between different sources of contextual effects. If the two measures of educational attainment among peer fathers are important, they would be consistent with hypotheses based on collective socialization, or 'role models' (Crane (1991), for example). The average peer household income should be a proxy for community wealth and perhaps for the level of material resources available to the school.

The fourth panel of table 1 presents measures of context at one less remove from the individual. These five variables measure characteristics of peers themselves: the percentages reporting that they planned to attend college, pursue a white collar occupation, enter the military or engage in farming[14], and the average IQ.[15]

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[12] Rowe (1997, 145-6) advocates analyses addressing multiple contextual levels: "Analyses of environments should also adopt nested analytical strategies. ... By analyzing hierarchically, one may reveal environmental effects at a particular level of the social system." Jencks and Mayer (1990, 177) recommend that explorations of contextual effects should focus on "the most politically salient and easily understood" variables. In this data set, however, the specification described below yields much richer results than one limited to, for example, average peer IQs and average peer household incomes.

[13] Case and Katz (1991) disregard the information available in their sample regarding the parents of other children in the same neighborhood because "parent peers may not provide a representative sample of non-familial adult behavior in a youth's neighborhood" (pg. 13). However, 'relatedness' rather than 'representativeness' is the important analytical issue. In Case and Katz (1991), nothing is known about the extent of contact between observed individuals and parents of other 'neighborhood' children. Here, it is plausible that the parents of peers exercise some influence, directly or otherwise, over sample individuals. Therefore, these data provide a useful opportunity to test for both the presence and proximity of adult-based contextual effects.

[14] The '% planning college' is the proportion of respondents from each high school answering "yes" to "Ever plan to attend college?". The three occupational variables represent the proportions choosing among mutually exclusive responses to "Respondent's intended occupational class".

[15] Wisconsin administrative records provide IQ scores from the Henmon-Nelson Test of Mental Ability, administered to eleventh graders. According to Jencks, et. al (1979, 93), Robert Hauser "estimates the reliability of this test to be between 0.92 and 0.95." Herrnstein and Murray (1994, 584) report a correlation of .71 between scores on this test and on the AFQT for 152 NLSY respondents. Christopher Jencks states (private communication) that, for unknown reasons, this test "yields lower correlations with both its causal antecedents ... and respondents' later attainments than most other reliable cognitive tests". This may imply a downward bias in the IQ effects estimated here.

Table 1

Summary Statistics, Contextual Variables

Variable	Mean	Standard Deviation
Area Population:		
High school in town <10,000 population	0.287	0.452
High school in town >49,999 population	0.272	0.445
School Characteristics:		
Private School	0.0159	0.125
Catholic School	0.0997	0.300
Size of High School Graduating Class	174.	133.
Peer Household Characteristics:		
Average Household Income ($10,000s)	3.01	1.16
% Father Graduated HS	0.315	0.120
% Father Graduated College	0.0856	0.0951
Peer Characteristics:		
Average IQ	101.	5.12
% Planning College	0.752	0.125
% Planning White Collar Occupation	0.731	0.132
% Planning Military Service	0.0461	0.0505
% Planning to Farm	0.0348	0.0605
Friend Characteristics:		
Friends Planning College	0.385	0.487
Friends Planning Jobs	0.328	0.470
Friends Planning Marriage	0.00406	0.0636
Friends Planning Military	0.317	0.465
Plans of Friends Unknown	0.0517	0.221

Notes: All income variables are in 1992 dollars. The sample consists of 2,959 men.

These variables provide opportunities to distinguish between hypotheses regarding the sources of contextual effects. As examples, the estimated effects of average peer IQ test the assumption that peer ability is an input into the educational production function. Those of peer-reported ambitions test the importance of the epidemic or 'contagion' effects.

'Friends' represent a level of context that is both more intimate and, presumably, more influential than peers. Measures of their characteristics provide the opportunity to assess the relevance of various hypotheses regarding contextual effects at this level, as well as to compare the corresponding effects of friends and of peers. The last panel of table 1 presents five variables measuring friends' 'post-high school' aspirations, as characterized by each respondent.[16]

Measures of the characteristics of high school classmates are rare, and of friends appear to be unique in the literature examining contextual effects. The WLS also includes a full complement of the variables ordinarily employed to measure family characteristics, representing the most intimate contextual level.

Table 2 presents average values for these variables. Among them are extensive sets of dummy variables for mother's and father's education and occupation, household structure and parental attitudes towards college educations.

These variables also include five that are continuous: sibling counts distinguished by gender and birth order, and household income. Most analyses of contextual effects aggregate the four sibling counts here into a single sum (Haveman and Wolfe (1995)). Disaggregation permits tests of both this aggregation and other hypotheses: For example, significant and similar coefficients on the number of older brothers and the number of older sisters would be consistent with birth order effects, but inconsistent with 'role model' effects (Haveman and Wolfe (1995), 1834) unless the latter are not gender-specific.[17]

The household income variable in the WLS is also unique: the average of parental

[16] These variables summarize "Respondent's perception of friends' probable post-high school behavior". The relevant horizon is much shorter than that for the self-reported peer aspirations, described in footnote 14. This difference probably explains the differences between reported plans.

[17] Case and Butcher (1994) claim that sibling effects depend on gender composition for women. However, Kaestner (1997) asserts that gender composition is unimportant for women or men. The analysis here disregards detailed 1975 WLS data describing a single randomly-selected sib. These data are contemporaneous with the first earnings observations rather than with the high school experience, and not available for the entire sample.

Table 2

Summary Statistics, Individual and Household Variables

Variable	Mean	Standard Deviation
Individual Characteristics:		
IQ	102.	14.9
1974 Labor Market Earnings ($10,000s)	4.47	2.35
Parental Attitudes:		
Parents Encouraged College	0.608	0.488
Parents Discouraged College	0.0277	0.164
Parents Did Not Permit College	0.00203	0.0450
Family Resources:		
Household Income ($10,000s)	3.09	3.07
Father's Education:		
Did Not Attend High School	0.343	0.475
Attended High School	0.170	0.375
Graduated High School	0.184	0.387
Trade School	0.0838	0.277
Attended College	0.0575	0.233
Graduated College	0.0669	0.250
Graduate Work	0.0253	0.157
Mother's Education:		
Did Not Attend High School	0.266	0.442
Attended High School	0.170	0.375
Graduated High School	0.304	0.460
Trade School	0.0507	0.219
Attended College	0.0402	0.196
Graduated College	0.0855	0.280
Graduate Work	0.00845	0.0915
Father's Occupation:		
Farmer	0.181	0.385
Laborer	0.139	0.346
Private Household Worker	0.0335	0.180
Operative	0.171	0.377
Craftsman	0.166	0.372
Clerical Worker	0.0946	0.293

Table 2, continued

Summary Statistics, Household Variables

Variable	Mean	Standard Deviation
Mother's Occupation:		
Farmer	0.00372	0.0609
Laborer	0.0429	0.203
Private Household Worker	0.0693	0.254
Operative	0.0395	0.195
Craftsman	0.00608	0.0778
Clerical Worker	0.121	0.326
Proprietor	0.00541	0.0733
Manager	0.00575	0.0756
Professional/Technical	0.0331	0.179
Student/Housewife/Not Recorded	0.674	0.469
Headship:		
Mother Head of Household	0.0385	0.192
Father Head of Household	0.0132	0.114
Stepfather Head of Household	0.0132	0.114
Other Head of Household	0.0108	0.103
Sibling Structure:		
Number of Younger Brothers	0.913	1.23
Number of Younger Sisters	0.834	1.10
Number of Older Brothers	0.692	1.13
Number of Older Sisters	0.666	1.05

Notes: All incomes are in 1992 dollars. The sample consists of 2,959 men.

incomes reported to the Wisconsin Department of Revenue during the four years beginning in 1957, taken directly from administrative files. It is therefore based on a rigorously consistent definition for all observations. Consequently, it is a more accurate proxy for permanent income than are measures employed by previous analyses of contextual effects.

Lastly, table 2 presents average values for two essential characteristics of the respondents, themselves. Footnote 15 describes the first, respondent IQ. The second is self-reported labor market earnings in 1974, at approximately age 35.

At this age the individuals examined here were, for the most part, slightly more mature labor force members than those in the papers surveyed in Haveman and Wolfe (1995) and Mayer and

Jencks (1990). A subsample of 2,264 individuals also reported earnings in 1992, at approximately age 53. Sections IV and V analyze the relationships between family and contextual variables and earnings in these two years, respectively. Together, these analyses offer a unique opportunity to examine the persistence of individual resources and contextual effects over the life-cycle.

The WLS contains variables that are contemporaneous with earnings at ages 35 and 53. However, the posture in this paper is that of attempting to distinguish, in the last year of high school, those likely to enjoy relatively high incomes throughout adulthood from those whose subsequent incomes might be unacceptably low in the absence of additional encouragement or investment. Therefore, all the explanatory variables in analyses here are measured in or before the last year of high school, with the exception that the household income variables incorporate information through 1960. With this last exception, all pre-date earnings in 1974 by at least 17 years.

These analyses disregard later variables in order to avoid the analytical difficulty of accounting explicitly for all the indirect effects of adolescent contextual variables that appear through intervening variables measured at later ages. Instead, the equations here, as in most other analyses of contextual effects, estimate the net effects, direct and indirect, of variables describing the adolescent context.[18]

These estimates are statistically problematic where the contextual variables might be construed as endogenous.[19] For example, parental choice of high school may reflect unmeasured family-specific traits and attitudes that also affect the probability of near-contemporaneous behaviors, such as teen pregnancy. If so, consistent estimates of the relationship between high school characteristics and these behaviors requires explicit treatment of their joint dependence (Evans, Oates and Schwab (1992)).

Here, parental choice is again a determinant of high school and peer characteristics. However, the underlying links between this choice and children's economic success are the family-specific attitudes and aspirations regarding that success. Fortunately, the WLS provides explicit proxies for those attitudes in the variables measuring parental attitudes towards college attendance. These variables should absorb otherwise unobserved familyspecific effects that might influence the future

[18] Neal and Johnson (1996, 871-2) provide an especially clear justification for this analytical strategy: "The model underlying our empirical results views the amount of human capital youths have attained by their late teens as a predetermined initial condition that constrains the future path of human capital and, hence, future wages. After the late teens, further investments in human capital, work experience, and occupation are endogenous choices that affect wages but are constrained by the initial level of human capital. ... reduced-form wage equations are appropriate because we are primarily interested in the total effect of race [or, here, of personal and contextual characteristics] on wages after age 18, not the partial effect conditioning on endogenous covariates."

[19] Statistical estimates of contextual effects are also problematic where the respondent's behavior depends directly on the analogous behavior of peers (Manski (1995)). However, this 'reflection problem' does not arise here. Theoretically, respondent earnings at age 35 do not depend directly on the contemporaneous earnings of high school peers. Instead, the abilities, resources and behaviors of other adolescents and adults during the high school years affect future income indirectly, through their direct influence on individual decisions regarding adolescent investments in human capital.

economic success of male children and that remain orthogonal to the array of other household-specific variables.[20]

IV. Earnings at age 35

Table 3 presents the results from the regression of the natural log of earnings at age 35 on the array of explanatory variables available for the entire sample, as described in the previous section. Respondents with higher IQ's have significantly greater log earnings. An increase of 15 IQ points, approximately equal to a standard deviation, implies an earnings difference of approximately 6.5%.

However, this effect is barely one-third as large as the estimates in Bishop (1989) and Neal and Johnson (1996). As suggested in the introduction, this difference is attributable to the omission of controls for high school and family context in previous work.[21] This effect is no greater than typical estimates of the return to an additional year of schooling and less than half of the estimates preferred by Ashenfelter and Krueger (1994).[22]

Respondents whose families had higher incomes had significantly but not markedly higher incomes themselves. The difference between $30,000 and $60,000 of parental income (in 1992 dollars), roughly equal to the sample mean income and the income level one standard deviation above the mean, implies a difference in sons' earnings of approximately 7.4%. In other words, a dramatic difference in parental income yields differences in sons' incomes that are again comparable to those arising out of an additional year of education.

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[20] The WLS reports a larger set of parental expectations and attitudes for a subset of the individuals examined here. Within this subset, parental aspirations regarding college attendance are highly-correlated with other expressions of parental attitudes. The case for the endogeneity of friends variables is slightly stronger, because the respondent was presumably responsible for the choice of friends rather than the parents. Nevertheless, this choice predates measured income by at least 17 years. Therefore, the analysis here assumes that these variables are also essentially predetermined.

[21] For example, Neal and Johnson (1996, table 1, column 3) include only IQ, age and race as explanatory variables for log earnings. The equivalent specification here includes only IQ, because age and race do not vary. It estimates the 1975 return to a difference of one standard deviation in IQ as .113 log points. This specification, applied to 1992 income (see section V), estimates the return at .209 log points. These estimates bracket that of .172 in Neal and Johnson (1996) for men aged 26 through 29, and presumably differ from it because of differences in cohort age and year of observation.

[22] These regressions omit completed education because it is a consequence of high school experience and context. Furthermore, completed education and incomes at age 35 are more likely to be mutually endogenous. Illustratively, the regression of table 3, augmented by a variable measuring completed education, estimates a significant but small return of approximately 3.2% to an additional year of schooling. The coefficient on IQ in this equation, while still significant at better than 1%, declines by more than half, to .00283. This is consistent with, though the converse to, the assertion that "controlling for ability lowers -- but by no means eliminates -- the return to schooling." (Heckman (1995), 1111). However, it contradicts Herrnstein and Murray (1994, 97), "the correlation between intelligence and income is not much diminished by partialing out the contributions of education, work experience, marital status, and other demographic variables."

Haveman and Wolfe (1995, 1864) and Mayer (1997, 56-57) summarize previous

Table 3

The Determinants of 1974 Labor Market Earnings

Variable	Coefficient	t-Statistic
Constant	9.76	(36.2)
High School in town <10,000 population	0.0253	(0.953)
High School in town >49,999 population	-0.0290	(1.12)
Respondent IQ	0.00430	(6.37)
Household Income ($10,000s)	0.0291	(4.00)
Household Income ($10,000s squared)	-0.000509	(2.80)

	Father's Characteristics:		Mother's Characteristics:	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Education:				
Attended High School	-0.0454	(1.60)	-0.0300	(1.03)
Graduated High School	-0.0232	(0.803)	-0.0104	(0.389)
Attended Trade School	-0.0285	(0.774)	0.0390	(0.860)
Attended College	-0.0290	(0.665)	0.0466	(0.918)
Graduated College	0.0211	(0.458)	0.0232	(0.561)
Graduate Work	-0.0484	(0.690)	0.0128	(0.121)
Not Ascertained	-0.0365	(0.819)	0.0422	(0.958)
p-value		0.720		0.597
Occupation:				
Laborer	0.0135	(0.395)	0.146	(0.946)
Private Household Worker	-0.0290	(0.533)	0.121	(0.801)
Operative	0.0286	(0.862)	0.168	(1.08)
Craftsman	0.0365	(1.09)	0.212	(1.13)
Clerical Worker	0.102	(2.53)	0.113	(0.749)
Proprietor	0.0796	(1.94)	0.288	(1.50)

Table 3, continued

The Determinants of 1974 Labor Market Earnings

	Coef-ficient	t-Statistic		Coef-ficient	t-Statistic
Headship:			**Sibling Structure:**		
Father, Mother Absent	0.0759	(0.961)	Younger:		
Mother, Father Absent	0.0250	(0.507)	Brothers	0.000795	(0.101)
Stepfather	-0.0357	(0.453)	Sisters	-0.00329	(0.378)
Other Household Head	-0.0744	(0.852)	Older:		
p-value		0.705	Brothers	0.0130	(1.47)
			Sisters	-0.00451	(0.478)
			p-value		0.679
Parental Attitude Toward College Attendance:			**School Characteristics:**		
Encouraged	0.0707	(3.21)	Private	-0.155	(1.86)
Discouraged	0.0132	(0.236)	Catholic	0.0585	(1.78)
Did Not Permit	0.0424	(0.213)	Size of Class	0.000193	(1.87)
p-value		0.0155	p-value		0.0105
Peer Household Characteristics:			**Peer Characteristics:**		
Average Income	0.0295	(2.11)	Average IQ	0.000955	(0.399)
% of Fathers Graduated:			% Planning to Pursue:		
High School	-0.107	(1.14)	College	-0.0144	(0.154)
College	0.00695	(0.0461)	White Collar Job	-0.0491	(0.518)
p-value		0.0736	Military Service	0.132	(0.676)
			Farming	-0.393	(2.28)
			p-value		0.270
Friend Characteristics:					
Planning College	0.0523	(1.41)	Planning Jobs	-0.0387	(1.09)
Planning Marriage	0.0519	(0.365)	Planning Military	-0.0163	(0.485)
Plans Unknown	0.0106	(0.199)			
p-value		0.0122			
R^2		0.114	Adjusted R^2		0.0941

research as estimating that parental incomes have a much larger effect on those of their sons. However, Mayer (1997, 114) presents evidence that the true effects are smaller than previously believed, as demonstrated here.

Here, the variables measuring levels of educational attainment for both father and mother are collectively insignificant. Furthermore, none are individually significant.[23] This is consistent with Ashenfelter and Krueger (1994, 1166), who conclude that parental education has no consistent effects on children's wage rates.

Jencks and Mayer (1990, 120) assert that, in addition to parental income and educational attainment, proper controls for family socio-economic status must account for parental occupations and household structure. Table 3 demonstrates that log earnings at age 35 depend significantly on some individual occupations, but do not depend significantly on the variable clusters describing any of these three characteristics.[24]

While the effects of parental occupation and education are weak, parental attitudes have a strong impact on sons' earnings. The effect of parental encouragement regarding college attendance is positive and significant at better than 1%. It is approximately equal to that of a standard deviation increase in parental income, and again similar to that of a year of additional schooling.

According to table 3, sibling structure is unimportant. The variables measuring sibling counts are individually and jointly insignificant. This contrasts with previous research, where larger sibships are associated with less favorable social outcomes (Haveman and Wolfe (1995, table 3b), for example) and lower incomes for white males (Datcher (1982)).

In sum, the regression in table 3 demonstrates that sons' earnings at age 35 depend on own cognitive ability and some, but by no means all, family characteristics. Family material resources and parental aspirations are clearly important. Socialization, through exposure to some parental occupations, may also play a role. However, parental credentials, either educational or, in most cases, occupational, appear to have little influence.

Similarly, contextual levels beyond the family demonstrate important but selective effects. At the furthest remove, the size of the town of high school attendance in 1957 has no relationship to income in 1974. However, incomes increase modestly with the size of the high school attended by

[23] Haveman and Wolfe (1995, 1864) conclude that "estimates of the effect of parental educational choices on children's labor market attainments are difficult to interpret". They tentatively suggest (page 1873) that the problems of data reliability, multicollinearity and endogeneity that characterize analyses of contextual effects may justify adopting lower standards of statistical significance. The presentation here continues to focus on conventional levels of 10% or better, but addresses this problem through additional emphasis on the joint significance of variable clusters.

[24] Although Jencks and Mayer (1990, 120 and 176) assert the contrary, omitting these family variables does not alter the peer and friend effects estimated below.

the respondent. Incomes are highest for graduates of Catholic high schools and substantially lower for graduates of other private high schools.[25]

Characteristics of the community served by the high school are also important. The average parental income of high school peer households has a significant positive effect on income at age 35.[26] Furthermore, the magnitude of this effect is as large or larger than that of own-household income, though of course this variable has a much smaller range.

The effect of average peer household incomes is consistent with the general proposition that "(g)rowing up in a neighborhood with 'good' characteristics ... has a positive effect on a child's choices regarding ... earnings" (Haveman and Wolfe (1995, 1871).[27] The strength of this effect suggests that these incomes may represent both the level of community inputs into the educational process (de Bartolome (1990)), and socialization through exposure to successful members of the labor force.

The characteristics of high school peers, themselves, seem to have less influence on respondents' future earnings. These earnings significantly and substantially decline with increases in the proportion of peers who plan to engage in farming.[28] However, they are unaffected by the average peer IQ. This suggests that the positive ability spillovers that are central to models such as de Bartolome (1990) may not exist.[29]

Lastly, respondent's perceptions of the aspirations of their high school friends have a strong but diffuse relationship to respondents' later earnings. The individual coefficients for all aspirations are insignificant. However, they are collectively significant at nearly 1%. This suggests that friends

[25] The magnitude of the Catholic high school effect here is slightly higher than that estimated by Neal (1997, table 9, column a) in the NLSY, and of greater significance. The large negative effect of secular private high schools suggests that, among the institutions of this type represented in this sample, many may have been remedial in nature.

[26] Quadratic terms in average peer household income are insignificant and unimportant when entered into the regression of table 3.

[27] Jencks and Mayer (1990, 173) assert that "(a) high school's mean SES does not have much effect on its graduates' economic prospects" especially for whites in the northern United States, with controls for other exogenous influences (1990, 130 and 141). To the extent that measured socioeconomic status does not incorporate income, this is not inconsistent with the significance of peer family income here. Furthermore, it is supported by the absence of significant effects from peer paternal educational attainment.

[28] Analogously, Bishop (1989) estimates that his variable BORNFARM is associated with a reduction of 15% to 16% in weekly earnings as reported by the PSID.

[29] This paper assumes that table 3 presents unbiased estimates of the effects of individual and peer IQ. However, interpretations of IQ as a proxy for a more general 'ability' may depend on measurement error. The appendix presents a simple characterization of this error. It suggests that table 3 understates the effects of individual ability and overstates those of peer ability. If so, its results would be more consistent with previous estimates of small but consistently negative peer achievement spillovers in general (Jencks and Mayer (1990, 128)) and in the WLS (Hauser, Sewell and Alwin (1976)). As explained in section 3, own and peer household incomes are presumably free of measurement error by construction.

reliably influence future economic success, but via mechanisms that are captured only crudely by the available variables.[30]

These results demonstrate that, with the exception of place of residence, all represented high school contextual levels have at least one significant effect on future earnings. These earnings depend on characteristics of the school itself, its students, the parents of its students and the students who affiliate as friends.[31] Table 4 summarizes the magnitudes of these last three effects in confidence intervals for predicted log earnings based on 'improvements' of one standard deviation in the values of contextual variables.

The first line of table 4 presents the confidence interval for predicted log earnings based on the average values of all explanatory variables. The second line replaces the average values of each of the five variables describing friends' aspirations with values that differ from these averages by one standard deviation in the direction that would increase predicted log earnings, as given by the sign on the corresponding coefficient.[32] It demonstrates that a one-standard deviation 'improvement' in the quality of friends is associated with an increase of approximately six percent in predicted log earnings, and with increases of approximately four and eight percent in the lower and upper bounds of the associated confidence interval.

[30] The WLS reports the number of high school friends identified by respondents in 1975 and verified by surveyors, up to a maximum of three. The regression of table 3, estimated separately for respondents identifying three and fewer than three friends, demonstrates that friend effects are important only for the former group, while peer effects are important only for the latter. Regressions further stratifying the subsample with fewer than three friends suggest that peer effects are important only for those who remained in Wisconsin as of 1975. Similarly, among those with at least three friends, friend effects are much stronger for those who remain in the State. This suggests that moves disportionately occur among those who received little benefit from contextual effects. It may also indicate that the apparent effect of peer spillovers is attributable in part to continuing interactions. However, these implications are only tentative because moves out of state may be endogenous with income in 1974. Slightly fewer than half of the sample examined here identified friends who also appear in the WLS. Experimental regressions with this subsample yield inconsistent evidence regarding the additional predictive value of friend-reported variables.

[31] As the introduction suggests, the omission of IQ strengthens many of these effects. Jencks and Mayer (1990, 121-4) propose that interactions between individual, family and neighborhood characteristics may be important. None prove so here. When added to the specification of table 3, interactions between own and peer IQs, between own and peer household incomes and between IQ and income variables all yield consistently insignificant coefficients. In addition, quadratic specifications of IQ and income variables fail to reveal non-linear effects, except in the case of own household income.

[32] All confidence intervals assume that values for explanatory variables are fixed.

Table 4

Predicted 1974 log earnings and 95% confidence intervals

Explanatory variable values	Predicted 1974 log earnings	95% Confidence interval for predicted log earnings: Lower bound	Upper bound
Averages for all variables	10.60	10.58	10.62
One standard deviation improvements in friend characteristics	10.66	10.62	10.70
One standard deviation improvement in peer characteristics	10.64	10.59	10.70
One standard deviation improvement in peer household characteristics	10.65	10.61	10.69

Similarly, one standard deviation 'improvements' in the characteristics of high school peers and peer households increase predicted log earnings by about four and five percent, respectively. Depending on the simulation, upper and lower confidence interval bounds increase by from one- to eight-hundredths of a log point. As a rough summary, therefore, a one standard deviation increase in the 'quality' of any of these three contextual levels yields a smaller increase in earnings than one additional year of schooling.

The effects of one standard deviation improvements in context are also only slightly less than the effect associated with an increase of one standard deviation in IQ. This is a dramatic contrast to the general theme of Herrnstein and Murray (1994, Part II). They assert that variations in IQ are substantially more important than are 'equivalent' variations in socioeconomic status in the determination of social and economic experiences.[33]

V. Earnings at age 53

Table 5 explores the question of whether earnings at approximately age 53 are related to contextual effects during the high school years.[34] The first column presents the specification of table 3 for 1974 earnings in the subsample of observations with reported 1992 earnings. This

[33] Interpretations of the comparisons in Herrnstein and Murray (1994) are problematic, as discussed in Goldberger and Manski (1995) and Heckman (1995).

[34] The average and standard deviation for 1992 earnings are $54,658 and $54,735. The WLS documentation describes the data item for 1992 earnings as "wages, salary, commissions, and tips". It describes the item for 1974 earnings as "wages and salaries". "Commissions and tips" do not appear in the description for any 1974 data item.

confirms that the determinants of 1974 income in this subsample are largely similar to those in the entire sample of section III, with the exception that the effects of peers are less pronounced.

The second column of table 5 employs the same specification to explain the log of earnings in 1992. The explanatory variables, though measuring characteristics as of 1957, have similar explanatory power with respect to earnings in both years. The coefficients on respondent IQ and the income of the respondent's high school household have similar significance.[35]

Earnings in both years are insensitive to either the education or the occupation of either parent. Sibling structure is similarly unimportant.[36] However, the effects of parental attitudes are again significant and similar in magnitude in the two years.

Furthermore, in this subsample most contextual effects attain similar significance at

[35] Section VI considers interpretations of the difference between the IQ effects at ages 35 and 53. The 1992 log earnings regression in table 5, augmented by completed years of schooling, yields a schooling coefficient of .0788, significant at 1%, comparable to standard estimates and more than double the coefficient for age 35 (see footnote 22). This equation reduces the IQ coefficient to .00602, significant at 1%. Parenthetically, the further addition of 1974 log earnings to this specification reduces the coefficients on IQ and education to .00453 and .0619 respectively, both significant at 1%. The coefficient on 1974 log earnings is .557, significant at 1%.

[36] Inexplicably, log earnings in 1992 are higher for respondents whose high school households were headed by a single birth parent.

Table 5

The Determinants of Labor Market Earnings in 1974 and 1992

	1974:		1992:	
Explanatory Variables	**Coef-ficient**	**t-Statistic**	**Coef-ficient**	**t-Statistic**
Constant	9.59	(33.2)	9.43	(22.6)
Individual IQ	0.00409	(5.46)	0.00972	(8.94)
Household Income	0.0284	(3.57)	0.0384	(3.33)
Household Income^2	-0.000517	(2.71)	-0.000719	(2.60)
High school in town <10,000 population	0.00684	(0.234)	-0.0453	(1.07)
High school in town >49,999 population	-0.0355	(1.25)	-0.0287	(0.695)
Father's Education:				
Attended High School	-0.0525	(1.67)	-0.0443	(0.974)
Graduated High School	-0.0258	(0.820)	0.0292	(0.640)
Attended Trade School	-0.0162	(0.397)	0.0165	(0.279)
Attended College	-0.00705	(0.147)	0.0349	(0.500)
Graduated College	0.00377	(0.0752)	0.0688	(0.945)
Graduate Work	-0.0429	(0.573)	-0.0287	(0.264)
Not Ascertained	-0.0102	(0.207)	-0.0181	(0.252)
p-value		0.832		0.792
Mother's Education:				
Attended High School	-0.0375	(1.16)	-0.0647	(1.37)
Graduated High School	-0.0254	(0.873)	0.0368	(0.872)
Attended Trade School	0.0403	(0.809)	0.0886	(1.23)
Attended College	0.0137	(0.247)	-0.0874	(1.09)
Graduated College	0.00365	(0.0804)	0.0755	(1.15)
Graduate Work	0.00308	(0.0277)	0.241	(1.50)
Not Ascertained	0.00176	(0.0355)	-0.00126	(0.0175)
p-value		0.809		0.105
Father's Occupation:				
Laborer	0.0299	(0.800)	0.0108	(0.200)
Private Household Worker	0.0142	(0.241)	-0.0219	(0.256)
Operative	0.0539	(1.47)	0.000188	(0.00354)
Craftsman	0.0808	(2.16)	-0.00371	(0.0684)

Table 5, continued

	1974:		1992:	
Explanatory Variables	**Coef-ficient**	**t-Statistic**	**Coef-ficient**	**t-Statistic**
Other	0.231	(2.07)	0.114	(0.706)
p-value		0.187		0.721
Mother's Occupation:				
Laborer	0.0299	(0.800)	0.0311	(0.137)
Private Household Worker	0.0142	(0.241)	0.0712	(0.318)
Operative	0.0539	(1.47)	0.238	(1.04)
Craftsman	0.0808	(2.16)	0.253	(0.916)
Clerical Worker	0.118	(2.65)	0.0585	(0.264)
Proprietor	0.0816	(1.78)	-0.102	(0.345)
Manager	0.0824	(1.50)	0.0515	(0.183)
Professional/Technical	0.0661	(1.25)	0.138	(0.597)
Other	0.231	(2.07)	0.0894	(0.410)
p-value		0.569		0.539
Household Headship:				
Father, Mother Absent	0.0887	(0.972)	0.475	(3.59)
Mother, Father Absent	0.0611	(1.12)	0.160	(2.03)
Stepfather	-0.0352	(0.419	-0.00293	(0.0241)
Other	0.00157	(0.0147)	-0.0951	(0.615)
p-value		0.664		0.0017
Sibling Structure:				
Younger Brothers	0.00359	(0.422)	0.0189	(1.54)
Younger Sisters	0.000455	(0.0479)	0.00496	(0.361)
Older Brothers	0.0147	(1.45)	-0.00718	(0.489)
Older Sisters	0.000742	(0.0703)	0.0169	(1.10)
p-value		0.630		0.393
Parental Attitude Toward College:				
Encouraged	0.0919	(3.78)	0.101	(2.86)
Discouraged	0.0272	(0.420)	-0.140	(1.49)
Did Not Permit	0.0860	(0.408)	0.150	(0.491)
p-value		0.0025		0.0068
School Characteristics:				
Private	-0.192	(2.07)	-0.271	(2.03)

Table 5, continued

	1974:		1992:	
Explanatory Variables	**Coef-ficient**	**t-Statistic**	**Coef-ficient**	**t-Statistic**
Peer Characteristics:				
Average IQ	0.00330	(1.26)	-0.0000882	(0.0232)
% Planning College	-0.00335	(0.0329)	-0.0607	(0.411
% Planning White Collar	-0.0823	(0.799)	-0.0436	(0.292
% Planning Military Service	0.0858	(0.399)	0.439	(1.41)
% Planning to Farm	-0.263	(1.38)	-0.327	(1.18)
p-value		0.521		0.488
Peer Household Characteristics:				
Average Household Income	0.0184	(1.21)	-0.00332	(0.151)
% Father Graduated HS	-0.0990	(0.966)	-0.0888	(0.597)
% Father Graduated College	0.106	(0.647)	0.348	(1.46)
p-value		0.204		0.325
Friend Characteristics:				
Planning College	0.0374	(0.896)	0.0662	(1.09)
Planning Jobs	-0.0541	(1.38)	-0.0626	(1.10)
Planning Marriage	-0.0342	(0.177)	0.133	(0.474)
Planning Military	-0.0370	(0.986)	-0.0350	(0.642)
Plans Unknown	-0.00245	(0.0409)	-0.0535	(0.617)
p-value		0.0181		0.0260
R^2		0.125		0.146
Adjusted R^2		0.0991		0.121

Notes: The dependent variables are the natural logarithms of 1974 and 1992 annual wages and salaries, measured in 1992 dollars. The sample consists of 2,264 men.

Table 6

Predicted 1974 and 1992 log earnings and 95% confidence intervals

Explanatory variable values	Predicted log earnings	95% Confidence interval for predicted log earnings: Lower bound	Upper bound
1974:			
Averages for all variables	10.61	10.59	10.63
One standard deviation improvements in friend characteristics	10.67	10.61	10.74
One standard deviation improvement in peer characteristics	10.66	10.60	10.72
One standard deviation improvement in peer household characteristics	10.65	10.61	10.70
1992:			
Averages for all variables	10.65	10.62	10.68
One standard deviation improvements in friend characteristics	10.74	10.66	10.83
One standard deviation improvement in peer characteristics	10.71	10.63	10.78
One standard deviation improvement in peer household characteristics	10.69	10.61	10.79

ages 35 and 53.[37] The earnings discount associated with attendance at a non-Catholic private high school is greater at age 53 than at age 35 and of equivalent significance. The respondent-reported friend variables once again fail to attain significance individually but are jointly significant at bette

[37] Haveman and Wolfe (1995, 1874) suggest that "individuals appear to follow quite different trajectories as they move toward their ultimate attainments in life." This may be consistent with the experiences of WLS respondents: The correlation between earnings at ages 35 and 53 is only .531. That between log earnings at these ages is .470. However, table 5 demonstrates that the effects of high school characteristics on earnings at ages 35 and 53 are quite similar. This implies that the components of life trajectories that depend on these characteristics do not differ greatly. The differences must arise out of the idiosyncratic disturbances that account for the majority of the variances in earnings.

than 5%. These results suggest that the influence of high school contextual levels on labor market performance can persist through most of the working life.[38]

Table 6 suggests that, if anything, the effects of high school context on log earnings are slightly more important at age 53 than at age 35. As in table 4, one standard deviation improvements in friend, peer and peer household variables imply increases in log earnings at age 35 that are slightly smaller than lower estimates of the returns to a year of schooling. The analogous increases in log earnings at age 53 are marginally greater, especially for improvements in the characteristics of friends.

VI. High school fixed effects and high school class rank

The analyses of sections IV and V include an exhaustive array of explicit contextual measures in order to identify all sources of contextual effects as precisely as possible. The results demonstrate that these effects occur at a variety of levels. However, they are by no means overwhelming in magnitude. Furthermore, the regressions in which they appear exhibit R^2 values that do not noticeably exceed those typically obtained in log earnings regressions on data containing few or no contextual variables.

These comparisons suggest either that a large proportion of the adult income generation process is completely orthogonal to high school contextual effects, or that the analyses here still omit important contextual characteristics. This latter possibility can be partially tested through the inclusion of high school-specific fixed effects. Dummy variables for each high school will absorb any fixed contextual effects at this level. Their inclusion should therefore give some indication of the maximum explanatory power that can be attributed to these effects, regardless of source.

This strategy has an obvious disadvantage: In the absence of detailed information regarding each high school, the behavioral foundations of any significant effects associated with their dummy variables will be inaccessible. Furthermore, these dummy variables preempt some of the behavioral interpretations presented above because they are perfectly collinear with, and therefore replace, the variable clusters describing school, peer and peer household characteristics.

However, this strategy also has a collateral advantage. The WLS reports rank in high school graduating class by percentiles. Comparisons of this variable across high schools are meaningless. However, in regressions that include high school fixed effects, this variable simply captures differences in rank within the same high school class.[39]

The use of this variable is consistent with the general posture adopted by this paper. It is another piece of information that would be available at age 17 for the purpose of predicting economic success subsequent to high school graduation. Furthermore, it is clearly predetermined

[38] Peers and peer household characteristics are jointly insignificant in both years. The absence of significant effects for 1974 log earnings suggests that the effects for the full sample may be less reliable than implied by their significance as indicated in table 3.

[39] Hauser and Sweeney (1997) also present a regression analysis of 1992 income with IQ and class rank among the explanatory variables. However, they pool males and females and omit high school fixed effects.

with regard to earnings at ages 35 and 53, and therefore an appropriate explanatory variable in the regressions here.

At the same time, the class rank variable presents an interpretive challenge. It is determined subsequent to, and therefore partially by, many of the other explanatory variables in this analysis. This raises the possibility that it is just an intervening variable between its precursors and later incomes.

However, more than half of the variation in class rank comes from sources other than family background, friends, peers, peer families, school characteristics and measured ability.[40] This suggests that class rank may embody some important individual characteristics that are not represented by other variables employed here. Only these characteristics, represented by that part of class rank that is orthogonal to all of the other explanatory variables, can have any explanatory power.[41] In other words, the class rank variable captures any differences that would arise in adult labor market earnings between two men with different class ranks from the same high school class, but with identical family, friend and peer characteristics, and most importantly the same measured IQ.

Measured cognitive ability is essentially non-malleable by the time of late adolescence. Gottfredson (1997, 2) asserts that it "is basically stable over the life span". According to Rowe (1997, 140), it appears to be only transitorily sensitive to changes in family environments. Neisser (1998, 16-17) concludes that "genetic factors contribute substantially to individual differences in intelligence ... Genetic differences contribute relatively more to the variability of IQ among adults". Neal and Johnson (1996, 891) estimate that approximately four years of additional secondary schooling would be necessary to change IQ scores (as measured by the AFQT) by the amount of a standard deviation.

The IQ variable therefore captures those elements of human capital that are determined relatively early in life.[42] Accordingly, the independent component of class rank must represent

[40] In the sample of table 3, the regressions of class rank on IQ alone and on all of the explanatory variables in that table yield R^2 values of .347 and .438, respectively.

[41] Greene (1997, 245-7) presents a representative proof of this result.

[42] Jencks, et. al (1979, 86) offer essentially the same interpretation: "Tests [of academic ability] given as early as sixth grade appear to predict educational attainment, occupational status, and earnings as well as tests given later. This suggests that it is not cognitive skill per se that affects later success. Rather, the stable motivations and aptitudes that lead to the development of cognitive skills also affect later success. A test's predictive power appears to derive in large part form its relationship to these stable underlying factors." These factors may include psychological traits such as 'locus of control' (Goldsmith, Veum and Darity (1997)) and 'motives' (Duncan and Dunifon (undated)). Smith, Brooks-Gunn and Klebanov (1997) suggest that cognitive ability is malleable at earlier ages on the basis of positive cross-sectional associations between early childhood ability and parental income. However, these associations may be attributable to parental cognitive ability, omitted from their analyses. The rapid secular increase in average IQ scores suggests that they respond to environmental changes. However, analyses of this increase (see the papers in Neisser (1998)) seem to imply that it is driven by differences in IQ scores across cohorts rather than changes in individual scores.

those elements that can be altered later in life. The empirical strategy that explores the upper bounds of the high school contextual contribution to adult incomes also distinguishes between what might be called the 'fixed' and 'variable' components of human capital, at least from the perspective of a high school student.[43]

There may be many components of each type. Implicitly, this paper has subsumed those that are fixed under the rubric of 'ability', understanding that this is represented by but not identical to IQ. Of those that are variable, effort is the most likely source of high school performance differences between two students that are identical in all other observed characteristics.[44] Therefore, this paper interprets the residual variance in the class rank variable as representing 'effort', recognizing that this interpretation may be partially symbolic.

The full sample contains individuals from 391 high schools. Individuals from 382 high schools appear in the sub-sample reporting 1992 incomes. Table 7 presents three regressions, each including dummy variables for each high school that appears in the associated sample. They offer only mixed evidence regarding the power of high school fixed effects.

All three regressions attain R^2 values that are approximately double those associated with earlier specifications. However, the adjusted R^2 actually declines for the log of 1974

[43] This strategy is not available with the public-use versions of the NLSY and the PSID because neither identifies high school. This information is presumably available in the original data for both. However, both are based on national samples from multiple high school classes. Whether either contains enough observations that share both class and high school to support estimates of high school performance effects analogous to those here is unknown.

[44] That part of high school rank that is orthogonal to all other variables here may reflect other characteristics such as the abilities to match interests and capacities to curricula and to choose courses with lower grading standards. These characteristics are only important here to the extent that they might plausibly lead to subsequent earnings differences. In addition, 'test-taking' ability may be important, but is probably captured by the test scores that measure IQ. Psychological characteristics affecting productivity may also have variable and fixed components. Goldsmith, Veum and Darity (1997) identify 'locus of control' as a fixed 'trait'. They estimate that 'self-esteem', its context-dependent expression, significantly affects contemporaneous income in the NLSY. Duncan and Dunifon (undated) identify 'motives' as a fixed 'disposition'. They offer indirect evidence that 'expectancies', its context-dependent expression, affect income in the PSID. However, common effects of either on high school rank and adult incomes would be attributable to the underlying fixed components, and presumably captured by IQ rather than rank.

Table 7

1974 and 1992 Earnings With High School Fixed Effects

Individual Explanatory Variables	**1974: 1974 Sample**	**1974: 1992 Sample**	**1992: 1992 Sample**
Individual IQ	0.00289	0.00289	0.00727
	(3.35)	(2.88)	(5.05)
High School Class Rank, Percentiles	0.00131	0.00126	.00266
	(2.88)	(2.39)	(3.53)
Household Income, ($10,000s)	0.0270	0.0270	0.0322
	(3.49)	(3.11)	(2.58)
Household Income^2 ($10,000^{2}s)	-0.000469	-0.000463	-0.000608
	(2.41)	(2.20)	(2.02)
Explanatory Variable Clusters:	**p-values**	**p-values**	**p-values**
Father's Education	0.385	0.477	0.907
Mother's Education	0.769	0.495	0.0356
Father's Occupation	0.484	0.553	0.644
Mother's Occupation	0.446	0.635	0.344
Household Headship	0.710	0.822	0.0037
Sibling Structure	0.556	0.513	0.240
Parental Attitudes	0.129	0.0117	0.0604
High School Fixed Effects	0.0452	0.928	0.589
Friend Characteristics	0.0309	0.109	0.0624
R^2	0.241	0.256	0.291
Adjusted R^2	0.104	0.0795	0.123
Sample Size	2,959	2,264	2,264

Notes: The dependent variables are the natural logarithms of 1974 and 1992 annual wages and salaries, measured in 1992 dollars.

earnings in the sample reporting earnings in 1992, and increases noticeably only for log of 1974 earnings in the complete sample. This latter regression is also the only instance in which the high school fixed effects are collectively significant.

These results do not support the suspicion that earlier specifications omit important elements of high school contexts. At the same time, they reinforce the importance of more intimate contextual effects. The variables representing friends' aspirations continue to be collectively significant, if marginally so in the equation for 1974 earnings among the subsample reporting

earnings in 1992. Even within high school class, something about the friends each member chooses is associated with their income for the subsequent 35 years.

The evidence regarding the effects of high school rank is much more dramatic. In all three regressions this variable is significant at better than 5%, and at better than 1% in two. An increase of ten percentile points in class rank is associated with an increase of more than 1% in 1974 earnings, and approximately 2.7% in 1992 earnings.

The increase in returns to class rank between 1974 and 1992 is proportionately similar to the increase in returns to IQ for this cohort, apparent in both tables 5 and 7.[45] Some portions of these increases are presumably attributable to the parallel increase in the standard deviation of ln earnings from .488 to .716. However, the increases in IQ and class rank effects are proportionately greater.

Changes in other significant coefficients, such as those on household income, parental encouragement to attend college, and private secular high schools, are proportionately less. Therefore, changes in the variability of dependent variables cannot explain all changes in coefficient magnitudes. At least some of the changes in the effects of IQ and class rank are likely to be attributable to changes in underlying economic forces.

These forces could include 'time' -- the evolution of the economic environment -- aging of the cohort in question, or both. However, the increase in returns to 'skill' from 1978 to 1986 identified by Murnane, Willett and Levy (1995) incorporates the effects of time and cohort differences. The similarity between these increases and those of table 7 is at least suggestive that the common time effects may be dominant.

The results here suggest further that these time effects may be of similar magnitude for cognitive ability and effort. Their consensus interpretation, as they pertain to cognitive ability, is in terms of skill-biased technical change (Bound and Johnson (1992), Herrnstein and Murray (1994), Juhn, Murphy and Pierce (1993) and Katz and Murphy (1992)). However, skill-biased technical change is unlikely to benefit the more diligent among those of similar skill as much as the more skilled among those of similar diligence.

This implies that some of the increased returns to class rank may derive from other increases in labor productivity that are not skill-biased. If so, these labor market trends deserve greater attention. They may include, for example, improvements in human resource management practices (Ichniowski, Shaw and Prennushi (1997)).[46]

The comparison between the effects of IQ and of high school rank is similarly provocative.

[45] Jencks, et al. (1979, 117) also find increasing within-cohort returns to adolescent cognitive ability over time in an earlier sample.

[46] These increases could also arise if employers estimate the productive value of worker characteristics with greater precision as they observe workers over longer periods. If employers discount payments for these characteristics to compensate for uncertainty regarding their value, these discounts should diminish with age.

According to the estimates for both 1974 and 1992, a difference of two to three percentile points in rank has the same effect as a difference of one IQ point. This suggests that the income advantage conferred by greater ability can be mitigated, to a substantial degree, by increased effort. Even if cognitive ability is relatively fixed, variations in effort can compensate, at least partially, for any inherited deficit.[47]

Lastly, this analysis reveals that the interaction between IQ and effort in the production of earnings has enormous implications for the apparent effect of IQ. Omitting the variable for high school class rank, the full sample regression for 1974 log earnings yields a coefficient of .00423 for IQ, with a t-statistic of 5.81. The analogous estimates for the regressions for 1974 and 1992 log earnings in the subsample reporting 1992 earnings are .00419 and 4.95, and .100 and 8.25. These estimates are approximately equal to those in tables 3 and 5.

The IQ coefficients in table 7 are approximately 40% smaller. In other words, the omission of controls for effort imparts a substantial upward bias to estimated effects of IQ. No previous analysis of the relationship between earnings and IQ has controlled for effort directly or through proxies. The implication must therefore be that all previous estimates of this relationship are similarly exaggerated.

The 1974 regressions of table 7 imply that a difference of one standard deviation in adolescent IQ causes a difference of .0434 in log earnings at age 35. Again, this is certainly no greater than the difference in log earnings attributable to a difference of three-quarters of a year of schooling, and may be as small as the difference attributable to an additional few months. The same difference in IQ is associated with a difference of .109 in log earnings at age 53. Analogously, this difference would also arise from a difference in education of between .6 and 1.8 years.

For Herrnstein and Murray (1994, 96), the difficulty of altering measured IQ implies that low-wage workers would benefit "only modestly" from additional education. However, this conclusion rests on the implicit assumption that additional education affects earnings largely through its effect on measured IQ. To the contrary, while four years of education may be necessary to close a gap of one standard deviation in IQ scores (Neal and Johnson (1996)), the results here suggest that less than one year of additional education would be necessary to erase the difference in earnings at age 35, and two years to erase the earnings difference at age 53, that results from that gap.

Heckman (1995, 1103) offers the following criticism of Herrnstein and Murray (1994): "Their implicit assumption of an immutable *g* [basic cognitive faculty] that is all-powerful in determining social outcomes leads them to disregard a lot of evidence that a variety of relevant labor market and social skills can be improved, even though efforts to boost IQ substantially are notoriously unsuccessful." This criticism is entirely consistent with the evidence here: Feasible increases in

[47] The assumption that individuals choose effort, conditioned by its marginal cost in utility terms, is at the foundation of the literature on tournaments (Lazear and Rosen (1981), McLaughlin (1988)). There, the marginal cost of effort is assumed to be a declining function of underlying ability. This implies a positive correlation between ability and effort, all else equal. Nevertheless, the optimal level of effort is positively related to the perceived returns to effort at any level of ability.

schooling probably have little effect on measured cognitive ability, but can markedly increase the earnings potential associated with any level of that ability.[48]

VII. Conclusion

The results demonstrated here distinguish between several of the economic theories describing the role of contextual effects in the production of human capital. The significance of peer household average incomes in tables 3 is consistent with the hypothesis that community wealth affects subsequent individual economic success, perhaps because it is correlated with the material inputs devoted to education. In contrast, the insignificance of average peer IQ throughout suggests that ability spillovers are unimportant. Similarly, 'role models' derived from the occupational or educational experiences of parents or peer parents, or from the presence of older siblings, appear to have little influence.

The results here also support several sociological explanations of contextual effects. Holding constant parents' occupations, the strong influence of peers planning to pursue farming could represent the effects of contagion or collective socialization. The collective importance of respondent-reported variables identifying friends' aspirations, especially in the absence of significant individual coefficients, again suggests that subsequent economic success depends in part on some diffuse process of socialization.

The evidence of more general spillovers is to some degree consistent with the assumptions supporting models of inter-community inequalities (Durlauf (1994), Benabou (1993)). The persistence of these spillover effects strengthens the claim that these inequalities can be durable. However, the suggestion that their extent is related to migration decisions (footnote 30) demonstrates that the link between externalities as experienced by individuals and the evolution of community-level welfare requires more study.

In sum, this paper demonstrates that individual adult economic performance is related to effects from several different adolescent contextual levels. The true effects of context almost surely arise from complicated and subtle social interactions that are only crudely approximated by the contextual measures available here. From this perspective, this analysis may still understate them.

At the same time, this paper demonstrates that measured cognitive ability has only modest effects on labor market performance. Sizeable differences in ability yield estimated earnings differences that could be eliminated with compensating differences of a year of schooling. In addition, the effects of ability differences on income are substantially overestimated in the absence of controls for effort, which can itself mitigate them.

[48] Gottfredson (1997, 9-10), concurs: "The search for a means to raise low intelligence should continue, but more attention might be turned to helping people make better use of the abilities they have. ... When the goal is to equalize outcomes, variation in intelligence is undoubtedly a bigger constraint when intelligence is more functionally important. For example, it can be expected to be a big constraint on changing variation in educational performance because educational success is strongly influenced by intelligence level. In contrast, the link between intelligence and income is much weaker".

Perhaps the most striking result here, is, however, the limited scope of all effects included in this analysis. At least 85% of the variation in earnings at age 35, and 75% of that at age 53, is orthogonal to everything measured as of age 18. Even with a generous allowance for measurement error and transitory income components in the variance that remains, there is plenty of opportunity for individuals to rise above or fall below the level to which their endowments and environment might direct them.

Appendix: Measurement error in ability

Assume that

1. IQ_i measures ability A_i with a random error ϵ_i that is uncorrelated with IQ_i, $A_i=IQ_i+\epsilon_i$, $COV(IQ_i,\epsilon_i)=0$;
2. Average peer IQ, IQ_P, measures average ability approximately without error because the errors in individual IQ measures are uncorrelated and approximately canceling. Consequently, $COV(IQ_P,\epsilon_i)\approx 0$;
3. Peer and individual abilities tend to be similar. Then, on average, if $IQ_i>IQ_P\approx A_P$ then IQ_i overstates A_i and ϵ_i is negative. Similarly, if $IQ_i<IQ_P\approx A_P$ then IQ_i tends to understate A_i and ϵ_i tends to be positive. This implies that $COV(IQ_i-IQ_P,\epsilon_i)<0$;
4. ϵ_i is uncorrelated with all other explanatory variables.

Suppressing the constant and all other explanatory variables for notational convenience, the estimating equation can be represented as

$$\begin{aligned} \ln Y_i &= \beta_1 A_i + \beta_2 A_P + \nu_i \\ &\approx \beta_1 (IQ_i + \epsilon_i) + \beta_2 IQ_P + \nu_i \\ &= \beta_1 (IQ_i - IQ_P) + (\beta_1 + \beta_2) IQ_P + \nu_i + \beta_1 \epsilon_i \ . \end{aligned}$$

The estimate of the coefficient of A_i, β_1, is biased downwards because it is associated in this version of the estimating equation with the variable IQ_i-IQ_P, which is negatively correlated with $\beta_1\epsilon_i$ in the residual. In this form, the estimating equation derives the coefficient of A_P, β_2, from the difference between the estimated coefficients of IQ_P and of IQ_i-IQ_P. The former is unbiased because IQ_P is uncorrelated with all residual terms. The negative bias in the latter therefore implies a positive bias in the difference.

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